

WHAT IS CLAIMED IS:

1. A substrate attracting and holding method,
comprising the steps of:

5 supporting a substrate by use of a protrusion
provided on a holding table for holding the substrate,
wherein the protrusion is disposed to be placed in a
predetermined positional relation with a position of
an alignment mark to be used for processing the
substrate or a position with respect to which an
10 alignment mark is to be produced; and

reducing a pressure between the holding table
and the substrate to attract and hold the substrate.

2. A method according to Claim 1, wherein the
15 substrate is supported so that the position of the
alignment mark or the position with respect to which
the alignment mark is to be produced is to be placed
above the protrusion.

20 3. A method according to Claim 1, wherein the
substrate is supported so that the position of the
alignment mark or the position with respect to which
the alignment mark is to be produced is to be placed
at a central portion in relation to disposition of the
25 protrusion.

4. A method according to Claim 1, wherein the

substrate is supported so that, for different processing regions of the substrate, the protrusion is to be placed at the same position.

5 5. A method according to Claim 1, wherein the substrate is supported so that the protrusion is placed at the same position with reference to the position of the alignment mark or the position with respect to which the alignment mark is to be produced.

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 6. A method according to Claim 1, wherein the position of the alignment mark or the position with respect to which the alignment mark is to be produced is placed outside a processing region of the

15 substrate.

 7. A method according to Claim 1, wherein at least a portion of the protrusion surrounds a zone corresponding the position of the alignment mark or

20 the position with respect to which the alignment mark is to be produced.

 8. A method according to Claim 1, wherein the protrusion comprises at least one of a rim type

25 protrusion and a pin contact type protrusion.

 9. A method according to Claim 1, wherein the

pressure of an air between the holding table and the substrate is adjusted.

10. A method according to Claim 9, wherein a
5 substrate attracting force in a processing region of the substrate is adjusted even for the whole substrate.

11. A method according to Claim 1, wherein at
10 least a portion of the protrusion surrounds a zone corresponding the position of the alignment mark or the position with respect to which the alignment mark is to be produced, and wherein the pressure of an air between the holding table and the substrate in a
15 region as surrounded by the protrusion is adjusted.

12. A method according to Claim 1, wherein
position adjustment is performed so that a
predetermined positional relationship is defined
20 between the protrusion of the holding table and the alignment mark or the position with respect to which the alignment mark is to be produced.

13. A substrate attracting and holding method,
25 comprising the steps of:

supporting a substrate by use of a protrusion provided on a holding table for holding the substrate,

wherein the protrusion has an attracting groove for attracting the substrate; and

reducing a pressure between the holding table and the substrate to attract and hold the substrate.

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14. A substrate attracting and holding system, comprising:

a holding table for holding a substrate;

a protrusion provided on said holding table,

10 said protrusion being disposed to be placed in a predetermined positional relationship with a position of an alignment mark to be used for processing the substrate or a position with respect to which an alignment mark is to be produced.

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15. A system according to Claim 14, wherein the protrusion is disposed so that the position of the alignment mark or the position with respect to which the alignment mark is to be produced is to be placed
20 above the protrusion.

16. A system according to Claim 14, wherein the protrusion is disposed so that the position of the alignment mark or the position with respect to which
25 the alignment mark is to be produced is to be placed at a central portion in relation to disposition of the protrusion.

17. A system according to Claim 14, wherein the protrusion is provided so that, for different processing regions of the substrate, the protrusion is to be placed at the same position.

18. A system according to Claim 14, wherein the protrusion is provided so that the protrusion is placed at the same position with reference to the position of the alignment mark or the position with respect to which the alignment mark is to be produced.

19. A system according to Claim 14, wherein the position of the alignment mark or the position with respect to which the alignment mark is to be produced is placed outside a processing region of the substrate.

20. A system according to Claim 14, wherein at least a portion of the protrusion is disposed to surround a zone corresponding the position of the alignment mark or the position with respect to which the alignment mark is to be produced.

21. A system according to Claim 14, wherein the protrusion comprises at least one of a rim type protrusion and a pin contact type protrusion.

22. A system according to Claim 14, further comprising a mechanism for reducing a pressure between said holding table and the substrate.

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23. A system according to Claim 22, wherein said mechanism comprises a pressure adjusting mechanism for adjusting a pressure of an air between said holding table and the substrate.

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24. A system according to Claim 23, wherein said pressure adjusting mechanism is arranged to produce a substrate attracting force in a processing region of the substrate which force is even for the whole substrate.

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25. A system according to Claim 14, wherein at least a portion of the protrusion is disposed to surround a zone corresponding the position of the alignment mark or the position with respect to which the alignment mark is to be produced, and said system further comprises a pressure adjusting mechanism for adjusting a pressure of an air between said holding table and the substrate in a region as surrounded by the protrusion.

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26. A system according to Claim 14, further

comprising a position adjusting mechanism for
adjusting a relative position of the protrusion of
said holding table and the alignment mark or the
position with respect to which the alignment mark is
5 to be produced, so that a predetermined positional
relationship is defined between them.

27. An exposure apparatus, comprising:
a holding table for holding a substrate;
10 a protrusion provided on said holding table,
said protrusion being disposed to be placed in a
predetermined positional relationship with a position
of an alignment mark to be used for processing the
substrate or a position with respect to which an
15 alignment mark is to be produced; and
exposure means for transferring, by exposure,
a pattern of an original to the substrate as attracted
and held by said holding table.

20 28. An apparatus according to Claim 27, further
comprising a controller for calculating an error in
coordinates of an alignment mark to be produced as a
result of deformation of the substrate as the same is
attracted, on the basis of a positional relationship
25 between the protrusion and the alignment mark of the
substrate.

29. An apparatus according to Claim 28, wherein
said controller has one of a function and a table for
calculating the error on the basis of the positional
relationship between the protrusion and the alignment
5 mark of the substrate.

30. An apparatus according to Claim 28, wherein
said controller is operable to correct the position of
the alignment mark as measured, on the basis of the
10 calculated error in coordinates of the alignment mark.

31. An apparatus according to Claim 28, wherein
said controller is operable to perform alignment of
the substrate on the basis of the error in coordinates
15 of the alignment mark.

32. A device manufacturing method, comprising the
steps of:

supporting a substrate by use of a protrusion
20 provided on a holding table for holding the substrate,
wherein the protrusion is disposed to be placed in a
predetermined positional relation with a position of
an alignment mark to be used for processing the
substrate or a position with respect to which an
25 alignment mark is to be produced;

reducing a pressure between the holding table
and the substrate to attract and hold the substrate;

and

printing a pattern of an original on the
substrate as attracted by the holding table.

5 33. A substrate attracting and holding system,
comprising:

 a holding table for holding a substrate;

 a protrusion for supporting the substrate and
having an attraction groove for attracting the
10 substrate; and

 a pressure adjusting mechanism for adjusting
a pressure between said holding table and the
substrate.

15 34. A substrate attracting and holding system
having a plurality of protrusions for supporting a
substrate, for attracting and holding the substrate
supported on the protrusions, characterized in that a
disposition pitch L of the protrusions and an
20 attraction force P of the substrate are set so as to
satisfy a relation:

$$P \cdot L^3 \leq [36 \cdot E \cdot h^2 \cdot dx dy] / [\sqrt{3} \cdot k \cdot c]$$

 where dx dy is a distortion tolerance, E is a
 longitudinal elasticity coefficient, h is a thickness
25 of the substrate, c is a correction coefficient based
 on the protrusion disposition and k is a neutral plane
 correction coefficient.

35. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that a disposition pitch L of the protrusions and an attraction force P of the substrate are set so as to satisfy a relation:

$$P \cdot L^3 \leq 0.00427.$$

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36. A system according to Claim 34 or 35, wherein the disposition pitch L and the substrate attraction force P are set to further satisfy relations:

$$G \cdot h \cdot \rho / \mu \leq P \leq 100000$$

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$$0.0005 \leq L \leq 0.005$$

wherein h is a thickness of the substrate, ρ is a density of the substrate, μ is a stationary friction coefficient of the substrate, and G is a maximum acceleration of a stage on which said substrate attracting and holding system is mounted.

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37. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that a disposition pitch L of the protrusions and an attraction force P of the substrate are set so as to

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satisfy relations:

$$P \cdot L^3 \leq 0.00427$$

$$33 \leq P \leq 100000, \text{ and}$$

$$0.0005 \leq L \leq 0.005.$$

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38. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that
10 the protrusions include an outer peripheral protrusion for supporting an outer peripheral portion of the substrate and a central protrusion for supporting a central portion of the substrate, inside the peripheral portion thereof, and that, when a disposition pitch of
15 the central protrusion is L_a and an attraction force of the substrate at the central protrusion is P_a while a disposition pitch between the outer peripheral protrusion and a central protrusion juxtaposed inside the outer peripheral protrusion is L_b and an
20 attraction force of the substrate between the outer peripheral protrusion and a central protrusion juxtaposed inside the the outer peripheral protrusion is P_b , the disposition pitches L_a and L_b and the attraction forces P_a and P_b are set so as to satisfy
25 relations:

$$P_a \cdot L_a^3 \leq [36 \cdot E \cdot h^2 \cdot dx dy] / [\sqrt{3} \cdot k \cdot c]$$

$$P_b \cdot L_b^3 \leq [8 \cdot E \cdot h^2 \cdot dx dy] / [k \cdot c]$$

where $dx dy$ is a distortion tolerance, E is a longitudinal elasticity coefficient, h is a thickness of the substrate, c is a correction coefficient based on the protrusion disposition and k is a neutral plane correction coefficient.

39. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that the protrusions include an outer peripheral protrusion for supporting an outer peripheral portion of the substrate and a central protrusion for supporting a central portion of the substrate, inside the peripheral portion thereof, and that, when a disposition pitch of the central protrusion is La and an attraction force of the substrate at the central protrusion is Pa while a disposition pitch between the outer peripheral protrusion and a central protrusion juxtaposed inside the outer peripheral protrusion is Lb and an attraction force of the substrate between the outer peripheral protrusion and a central protrusion juxtaposed inside the the outer peripheral protrusion is Pb , the disposition pitches La and Lb and the attraction forces Pa and Pb are set so as to satisfy relations:

$$Pa \cdot La^3 \leq 0.00427$$

$$Pb \cdot Lb^3 \leq 0.00164.$$

40. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that the protrusions include an outer peripheral protrusion for supporting an outer peripheral portion of the substrate and a central protrusion for supporting a central portion of the substrate, inside the peripheral portion thereof, and that, when a disposition pitch of the central protrusion is La and an attraction force of the substrate at the central protrusion is Pa while a disposition pitch between the outer peripheral protrusion and a central protrusion juxtaposed inside the outer peripheral protrusion is Lb and an attraction force of the substrate between the outer peripheral protrusion and a central protrusion juxtaposed inside the the outer peripheral protrusion is Pb , the disposition pitches La and Lb and the attraction forces Pa and Pb are set so as to satisfy relations:

$$Pa \cdot La^3 \leq 0.00427$$

$$33 \leq Pa \leq 100000$$

$$0.0005 \leq La \leq 0.005$$

$$Pb \cdot Lb^3 \leq 0.00164$$

$$33 \leq Pb \leq 100000$$

$$0.0005 \leq Lb \leq 0.005.$$

41. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that the protrusions include an outer peripheral protrusion for supporting an outer peripheral portion of the substrate and a central protrusion for supporting a central portion of the substrate, inside the peripheral portion thereof, that a disposition pitch of the central protrusion is made larger than a disposition pitch between the outer peripheral protrusion and a central protrusion juxtaposed inside the outer peripheral protrusion, and that an attraction force of the substrate at the central protrusion is made smaller than an attraction force of the substrate between the outer peripheral protrusion and a central protrusion juxtaposed inside the the outer peripheral protrusion.

42. A substrate attracting and holding system having a plurality of protrusions for supporting a substrate, for attracting and holding the substrate supported on the protrusions, characterized in that the protrusions include an outer peripheral protrusion for supporting an outer peripheral portion of the

substrate and a central protrusion for supporting a central portion of the substrate, inside the peripheral portion thereof, that a disposition pitch of the central protrusion is made not less than a disposition
5 pitch between the outer peripheral protrusion and a central protrusion juxtaposed inside the outer peripheral protrusion, and that an attraction force of the substrate at the central protrusion is made larger than an attraction force of the substrate
10 between the outer peripheral protrusion and a central protrusion juxtaposed inside the the outer peripheral protrusion.

43. A system according to any one of Claims 34 -
15 42, wherein a free end of the protrusion is formed into a spherical shape.

44. An exposure apparatus, comprising:
a substrate attracting and holding system as
20 recited in any one of Claims 34 - 43; and
exposure means for transferring, by exposure, a pattern of an original to a substrate as attract and held by said substrate attracting and holding system.

25 45. A device manufacturing method, characterized by producing a device through manufacturing processes including a process for exposing a substrate by use of

an exposure apparatus as recited in Claim 44.

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